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AMORPHACARUS YEZOENSIS SPEC. NOV. (ACARINA: PROSTIGMATA: MYOBIIDAE) FROM *SOREX UNGUICULATUS* (MAMMALIA: INSECTIVORA: SORICIDAE)

by

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and

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Lukoschus F.S., Z. Ono & K. Uchikawa: *Amorphacarus yezoensis* spec. nov. (Acarina: Prostigmata: Myobiidae) from *Sorex unguiculatus* (Mammalia: Insectivora: Soricidae.
Zool. Med. Leiden 59(24), 31-xii-1985: 283-297, figs. 1-21, tables 1-2. — ISSN 0024-0672.
Key words: *Amorphacarus yezoensis* spec. nov.; Acarina; *Sorex unguiculatus*; host; parasite.
Amorphacarus yezoensis spec. nov. parasitic on *Sorex unguiculatus* is described with developmental stages, and is compared to the related species *A. elongatus, A. alpinus* and *A. soricis.*
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INTRODUCTION

Contrary to the general opinion that myobiids have evolved together with their hosts (Fain, 1974, 1977) and that most hosts have their own host-specific myobiids, species of the genera *Protomyobia* Ewing and *Amorphacarus* Ewing are suggested to parasitize a number of host species (Jameson & Dusbabek, 1971; Whitaker & Wilson, 1974; Fain, Whitaker & French, 1982). Ono (1968) stated that "Hokkaido specimens of *Amorphacarus elongatus* differ slightly from the description of *A. elongatus* by Poppe, 1896 and by Rad-

ford, 1948, but more specimens are needed before we can confirm the differences between Hokkaido populations of *A. elongatus* and those of Europe".

Comparison of more than 100 specimens from *Sorex unguiculatus* Dobson from different localities in Japan and on Sakhalin Island and from *Sorex araneus* Linnaeus from Central European localities confirmed the existence of pronounced morphological differences. The greatly different shapes of the sclerotized genital regions are regarded as indicative of reproductive barriers which would prevent cross-breeding. The species from *Sorex unguiculatus* will be described here, including all developmental stages. The measurements are compared to the related species *Amorphacarus elongatus* (Poppe, 1896), *A. soricis* Fain & Whitaker, 1978 and the Japanese species *A. alpinus* Ono & Uchikawa, 1975 (Table 1). All measurements are given in μm.

SYSTEMATIC PART

Amorphacarus yezoensis spec. nov.
(figs. 1-13, 16, 21)

Amorphacarus elongatus (Poppe, 1896) sensu Ono, 1968: 192.

Material examined. — Holotype female, allotype male, 7♀, 6♂, 3 Trns, 5 Dns, 1 L, Nopporo, Hokkaido, 22-Juli-1972, leg. Ono; 9♀, 3♂, 1 Trn, 1 Dn, Barato, Hokkaido, 20-July-1972, leg. Ono; 21♀, 4♂, 4 Trns, 1 L, Maruyama, Sapporo, Hokkaido, 2-June-1961, leg. Ono; 1♀, 1♂, Mt. Daisetsu, Hokkaido, 13-July-1970, leg. Ono; 4♀, 2♂, 1 Trn, 2 Dns from the same locality, 2-July-1972, leg. Ono; 4♀, 4♂, 3 Trns, 2 Dns, 1 pn, Rishiri Is. off Hokkaido, 23-25-July 1965, leg Miyao; 1♀, 2♂, 3 Trns, 6 Dns, Tonden and Oyafuru, Saporro, 28-29-September-1983, leg. Uchikawa; 12♀, 1♂, 22 Trns, 8 Dns, 3 Le, Kulikovo, Sakhalin, June-1927, leg. Rall, Senckenberg Museum.

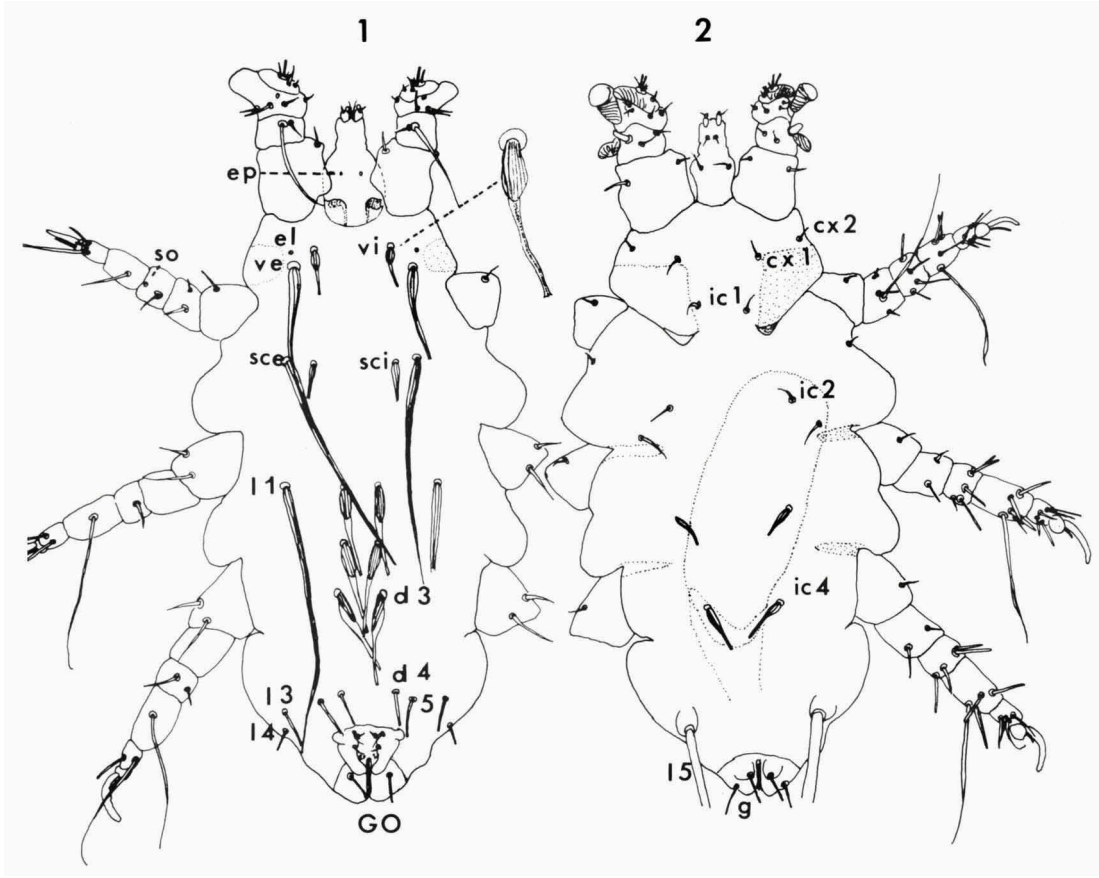
The host of all the above specimens is *Sorex unguiculatus* Dobson.

Deposition of types: Holotype, allotype and immatures in National Sciences Museum, Tokyo, Japan; paratypes in US National Museum of Natural History, Washington, D.C.; Field Museum of Natural History, Chicago; Bernice P. Bishop Museum, Honolulu, Hawaii, Zoologisches Museum, Hamburg; Rijksmuseum van Natuurlijke Historie, Leiden; Department of Life Sciences, Indiana State University, Terre Haure, Indiana; Senckenberg Museum, Frankfurt; Meguro Parasitological Museum, Tokyo; and in the collections of the authors.

Diagnosis. — With characteristics of the genus *Amorphacarus* Ewing, 1938 (sensu Jameson, 1970). Closely related to *A. elongatus* (Poppe, 1896). Larger than any species of genus hitherto described. Thirty females measured 572 (500-659) long and 300 (260-352) wide; 20 males, 490 (410-527) long and 222 (200-255) wide. Length/width ratio 1.9 in females and 2.2 in males, the lowest

for any species of *Sorex*. Cuticle of idiosoma finely striated with exception of genital regions, ventrally coxal region I and near leg bases. Striations mostly transverse, but longitudinal on lateral opisthosoma. All setae with distinct central core. Long setae of body and of leg segments with tapering filiform end, medium setae of idiosoma and legs with broadened blunt end.

Female (holotype). — Dorsum (fig. 1): Setae *v i* with long-oval, lengthwise striated scale, covering basal third of cored seta with bulbous enlargement and with typical, somewhat broadened blunt end. *V e* broadened without such scale. Region of *v i*, *v e* and supracoxal *e I* (formerly regarded a pore) dark coloured above, enclose organs beneath soft, striated cuticle (cf. sclerotized plate with *v i* and *v e* mentioned in *A. parvus* Jameson, 1970 and in male of *A. soricis* Fain & Whitaker, 1978). *V i* anterior to level of *v e*, *e I* anterior to



Figs. 1, 2. *Amorphacarus yezoensis* spec. nov., holotype female; dorsum (1) and venter (2).

v e. Sc i on, or slightly behind level of *sc e. Sc e* and *ℓ 1* in many specimens with broadened basal part, tapering to filiform end. Dorsals 1-3 with about equal distances between *d 1 – d 2* and *d 2 – d 3*; *d 4, d 5* and laterals 3 and 4 strong, blunt setae in almost transverse row. In few specimens more posterior barbs show two-parted construction (more distinct in *A. elongatus* and *A. alpinus*). Setae *ℓ 2* absent. Genital opening terminal with three pairs of stout, blunt genital setae (length 13-17) along genital aperture. Vulvar region (fig. 13) with long broad valves with curved genital hooks (*a 3*) (length 11) and unequal setae *a i* and *a e* (length 5, 12). Sclerotization between vulvar opening and genital aperture with two pairs of unequal genital setae *g 4, g 5* (length 8, 5). Short sclerotized duct (D) from vulvar opening to indistinct bursa copulatrix.

Venter (fig. 2): Present are *ic 1-4*, two pairs of coxal setae each in coxal fields I and II, and terminal setae *ℓ 5* on small tubercles. Region between *ic 1*, coxal setae and posterior border of coxal fields I unstriated, more sclerotized, forming paramedian ventral scutes arising from ventral surface.

Gnathosoma: Very slender with characteristics similar to those described in *A. parvisetosus* Lukoschus & Driessen, 1971. Supercoxal setae of palps (*e p*) distinct.

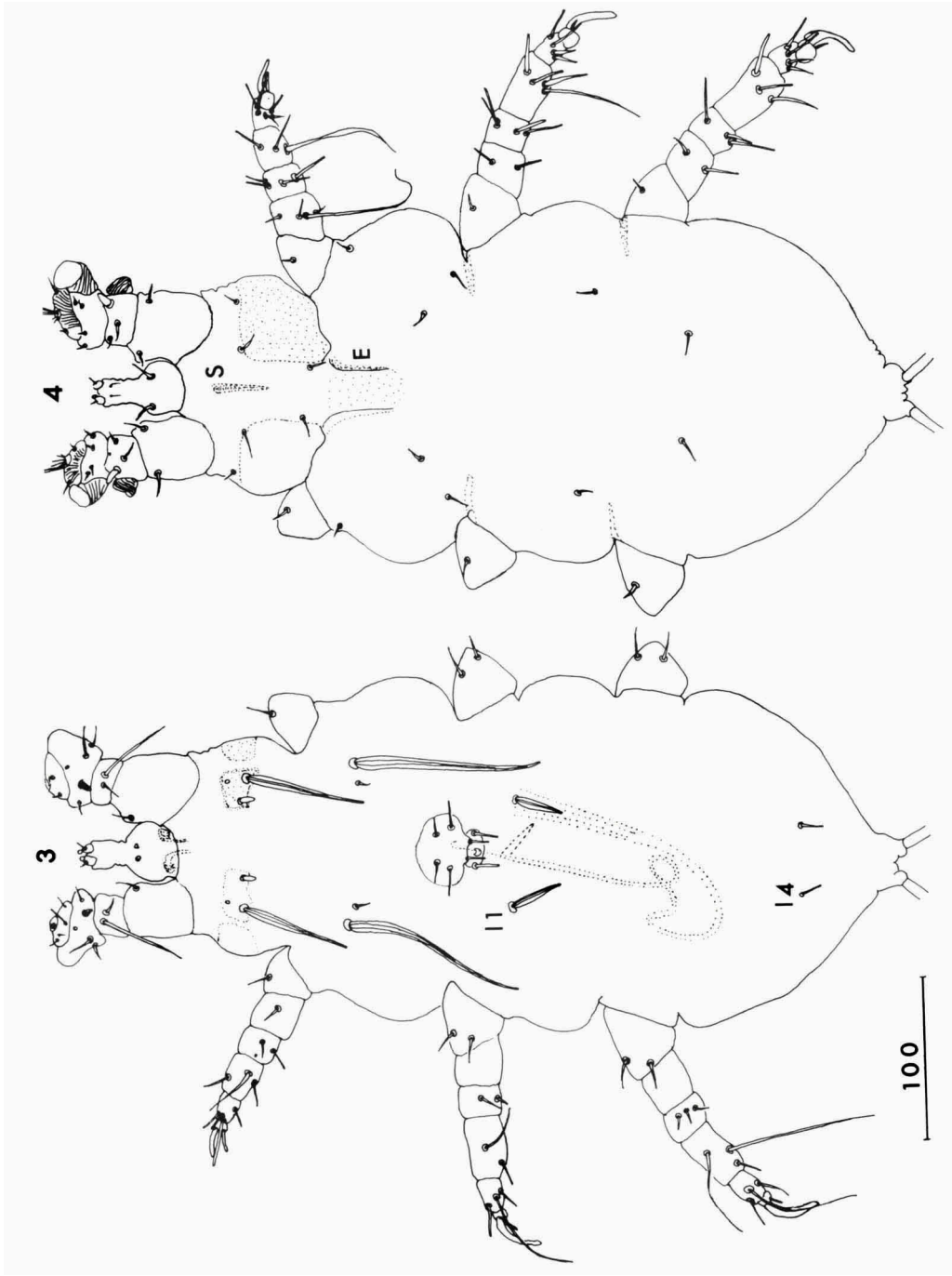
Legs: Legs I asymmetrical with characters similar to *A. parvisetosus*. Legs II-IV of slightly increasing length with most medium sized setae stout with blunt end; with distinct pretarsus with two claws. Second claw of legs II slender and 15-17 long, of legs III and IV 10 long. Chaetotaxy in table 1.

Male, allotype. — Length 510, width 225. Cuticle soft with fine striations, largely similar to female. Unstriated parts of coxal fields I extending laterally with sclerotizations stronger towards dorsal side.

Dorsum (fig. 3): Short, spine-like unstriated *v i* at level of *v e*. Short *ℓ 1* behind genital region. Only one pair of short, stout setae (*ℓ 4*) dorsally on opisthosoma. Genital shield (fig. 16) 31 long and 39 wide, rounded with three pairs of setae (length 8, 15, 10); shield lying partly over posteriorly directed penis. Genital shield with transverse fold. In specimens with aedeagus stretched out, penis base and posterior part of shield with third pair of setae directed craniad. Two small round sclerites each with one seta (length 14) lateral to penis base. Aedeagus long, double-coiled within sheath. A sclerotized duct from region behind *ℓ 1* to penis sheath in most paratypes.

Venter (fig. 4): Setation as in female. Parts of sternum (S) of epimera I visible on ventral cuticle as heavier sclerotization and absence of striations. Epimera II (E) paramedian behind ventral scutes with space between epimera unstriated.

Gnathosoma and legs as in female, but dorso-median seta on genu I con-

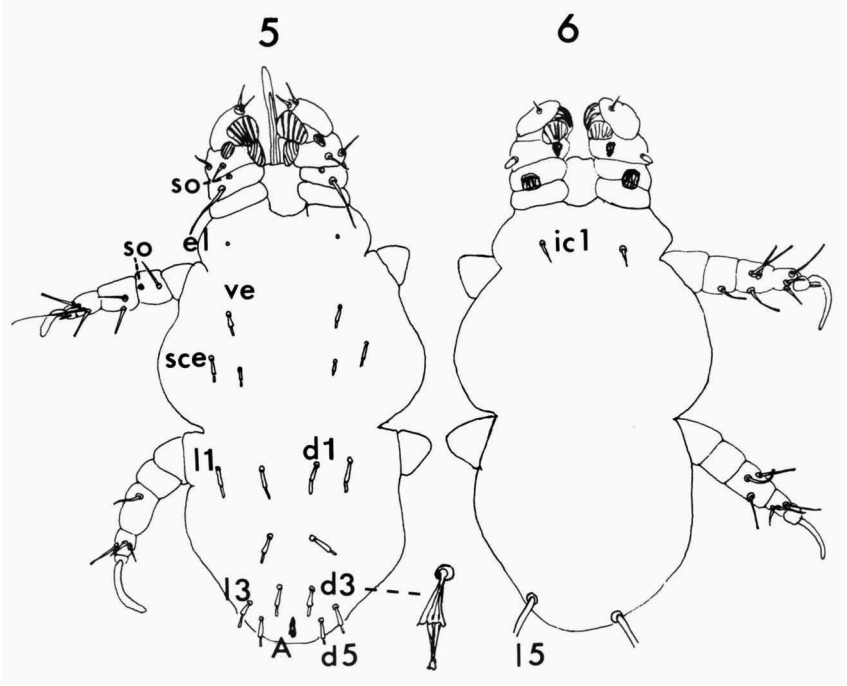


Figs. 3, 4. *Amorphacarus yezoensis* spec. nov., allotype male; dorsum (3) and venter (4).

ical, dorso-median setae of tarsi I and II longer and much stronger than in female. Solenidion *sigma* on genu I more distinct.

Eggs. — 240 × 100 and of usual shape for genus. In none of 14 paratypes with well-formed eggs was any evidence of a second egg observed. In two paratypes just before egg deposition the glue for attaching the egg to the hair of host was present within the female at caudal end of egg, as fixed to the host hair (fig. 2).

Larva. — Length including legs I in five specimens 253 (230-270), width 124 (117-129). Dorsum (fig. 5): Present are *v e, sc i, sc e, d 1-3, d 5, ℓ 1* and *ℓ 3*, all of uniform shape and size (10-17). Supracoxal seta *e 1* in the same position to legs I, *v e* shifted caudally to position behind legs II. Anal pore (A) dorso-caudal without anal setae. Venter (fig. 6): Present are setiform *ic 1* and long *ℓ 5*. Entire idiosoma finely striated. Gnathosoma a long trunklike stylophore without palps, quite unlike adults. Legs with four free articulated segments. Position of solenidion *sigma* (so) on legs I and II shows fusion of femur and genu. Legs I symmetrical with tibia and tarsus larger than other segments and



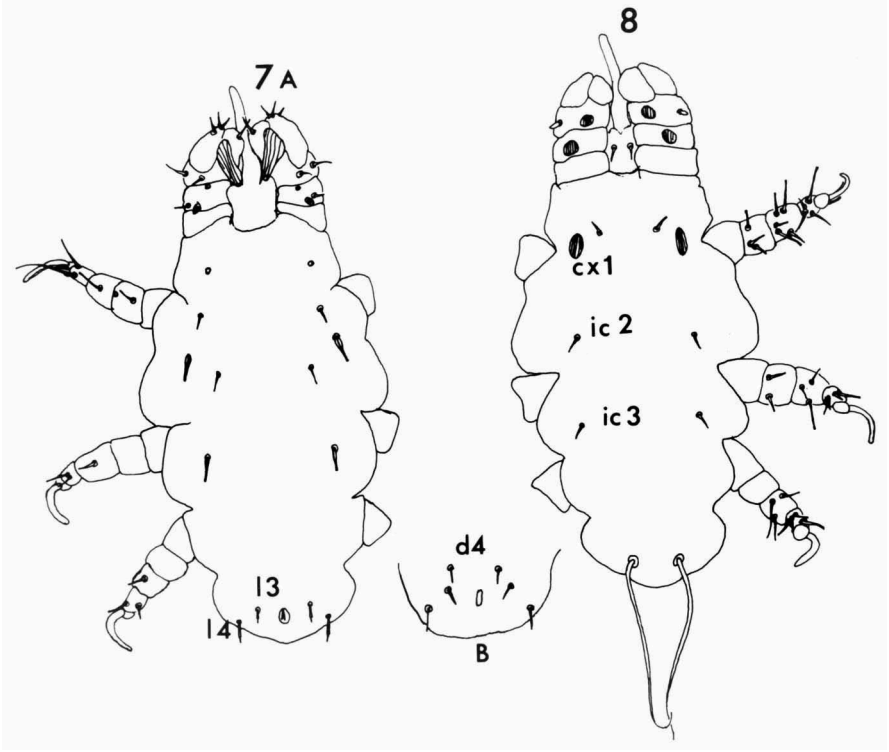
Figs. 5, 6. *Amorphacarus yezoensis* spec. nov., larva; dorsum (5) and venter (6).

with large functional claws. Two claws (25, 7) on distinct pretarsus of leg II, one claw (30) on leg II. Length differences of leg setae less pronounced than in adults. Chaetotaxy in table 1.

Protonymph. — Average length of three speciments 292, width 165. Entire idiosoma finely striated. Dorsum (fig. 7): Setation distinctly different from larva. Present are *e I, v e* (9), *sc i* (8), *sc e* (15), and *ℓ 1* (14) with scale-like part medially pointed as in adults, and *ℓ 3* (9) and *ℓ 4* (8) near "anal" pore. Setae *d 1-3* and *d 5* suppressed. In the protonymph of *A. elongatus* setae *d 4* are present (caudal end fig. 7B).

Venter (fig. 8): Added to setae of larva are *ic 2, ic 3* and first pair of broad, scale-like, striated coxals I (15). Laterals 5 absolutely and relatively shorter than in larva. Legs I slightly asymmetrical. Legs IV and some leg setae added to setation. Chaetotaxy in table 1.

Deutonymph. — Length of eight specimens measured 369 (332-400), width 170 (166-194). Cuticle soft with finely, mostly transverse striation. Added to setation of dorsum (fig. 9) are *d 5* and ventrally (fig. 10) *ic 4*. The deutonymph



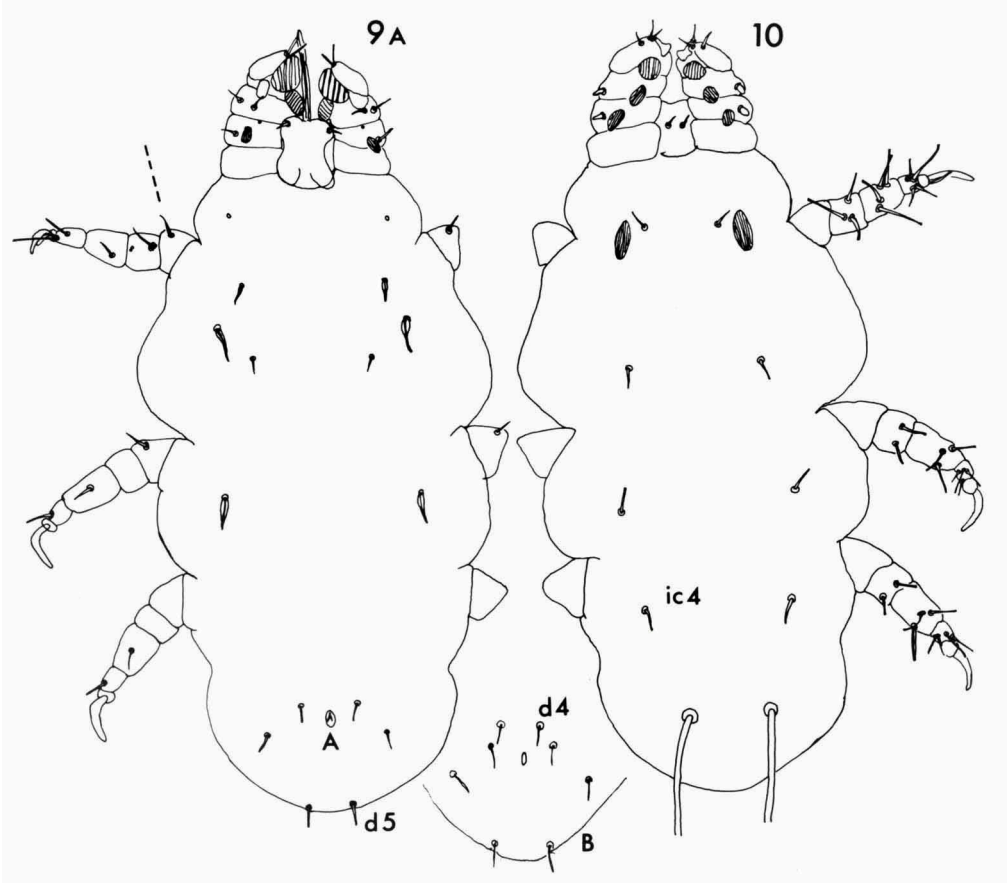
Figs. 7, 8. *Amorphacarus yezoensis* spec. nov., protonymph; dorsum (7 A) and venter (8). Posterior part of *A. elongatus,* protonymph (7 B).

of *A. elongatus* differs by presence of *d 4* (fig. 9B). Legs I more asymmetric. Most evident addition to leg setation are trochanter setae II and III. Chaetotaxy in table 1.

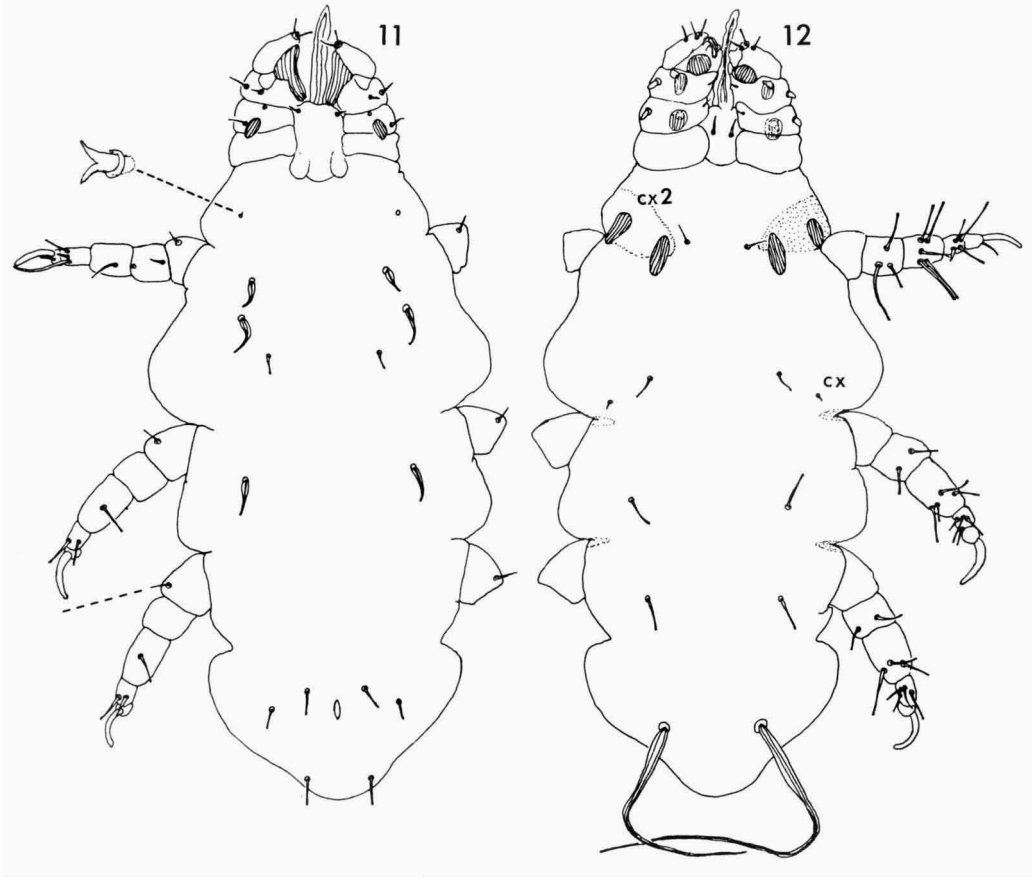
Tritonymph. — Length in 13 specimens measured 501 (445-580), width 232 (212-250). Cuticle soft with striations as in earlier stages, but region of coxals I and anterior articulations of legs III and IV unstriated.

Dorsum (fig. 11): Without additions to setation. All setae longer and stronger: *v e* (22), *sc i* (12), *sc e* (28), *ℓ 1* (24), *ℓ 3* (12), *ℓ 4* (11), *d 5* (15).

Venter (fig. 12): Added are second pair of coxal setae in field I as broad, striated scale (22 × 10) for anchoring, and one pair in coxal field II (4); *ic 3* and *4* stronger and longer (18) than *ic 1, ic 2* (10, 14). Legs I distinctly asym-



Figs. 9, 10. *Amorphacarus yezoensis* spec. nov., deutonymph; dorsum (9 A) and venter (10). Posterior part of *A. elongatus,* deutonymph (9 B).



Figs. 11, 12. *Amorphacarus yezoensis* spec. nov., tritonymph; dorsum (11) and venter (12).

	Larva			proto-nymph				dento-nymph				trito-nymph				adult			
	I	II	III	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
tarsus	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
claws	2	2	1	2	2	1	1	2	2	1	1	2	2	1	1	2	2	2	2
tibiae	5	5	4	6	6	4	4	6	6	5	4	6	6	5	5	6	6	6	6
genua	2	2	–	3	4	2	–	5	4	2	2	5	4	2	2	8	6	6	6
femora																5	5	2	2
trochanters	–	–	–	–	–	–	–	–	1	1	–	–	1	1	1	3	2	3	3
solenidia tarsi	2	2	–	2	2	–	–	3	2	–	–	3	2	–	–	3	2	–	–
genua	1	1	–	1	1	–	–	1	1	–	–	1	1	–	–	1	1	–	–

Table 1. Chaetotaxy of leg segments of *Amorphacarus yezoensis* spec. nov.

metrical. Most evident additional leg setae are trochanter setae IV. Tritonymphs not sexually dimorphic, except for smaller body size and shorter setae in male forming tritonymphs.

Etymology. — The species epithet is derived from Yezo, the old name of Hokkaido.

DISCUSSION

Seven species have previously been described in the genus *Amorphacarus* Ewing, 1938. They are:

A. elongatus (Poppe, 1896)	ex *Sorex araneus* Linnaeus	Germany
A. alpinus Ono & Uchikawa, 1975	*Sorex shinto* Thomas	Japan
A. soricis Fain & Whitaker 1978	*Sorex bendirii* (Merriam)	U.S.A.
A. hengererorum Jameson, 1948	*Sorex fumeus* Miller	U.S.A.
A. parvus Jameson, 1970	*Episoriculus fumidus* (Thomas)	Taiwan
A. phillipsi (Turk, 1945)	*Neomys fodiens* (Pennant)	England
A. parvisetosus Lukoschus & Driessen, 1971	*Neomys fodiens* (Pennant)	The Netherlands, Austria, Poland
	Neomys anomalus Cabrera	Poland, Austria

A. phillipsi was described on the basis of a single male. The loss of this specimen does not allow re-examination. However the short, curved penis causes one to question whether this species belongs in *Amorphacarus*.

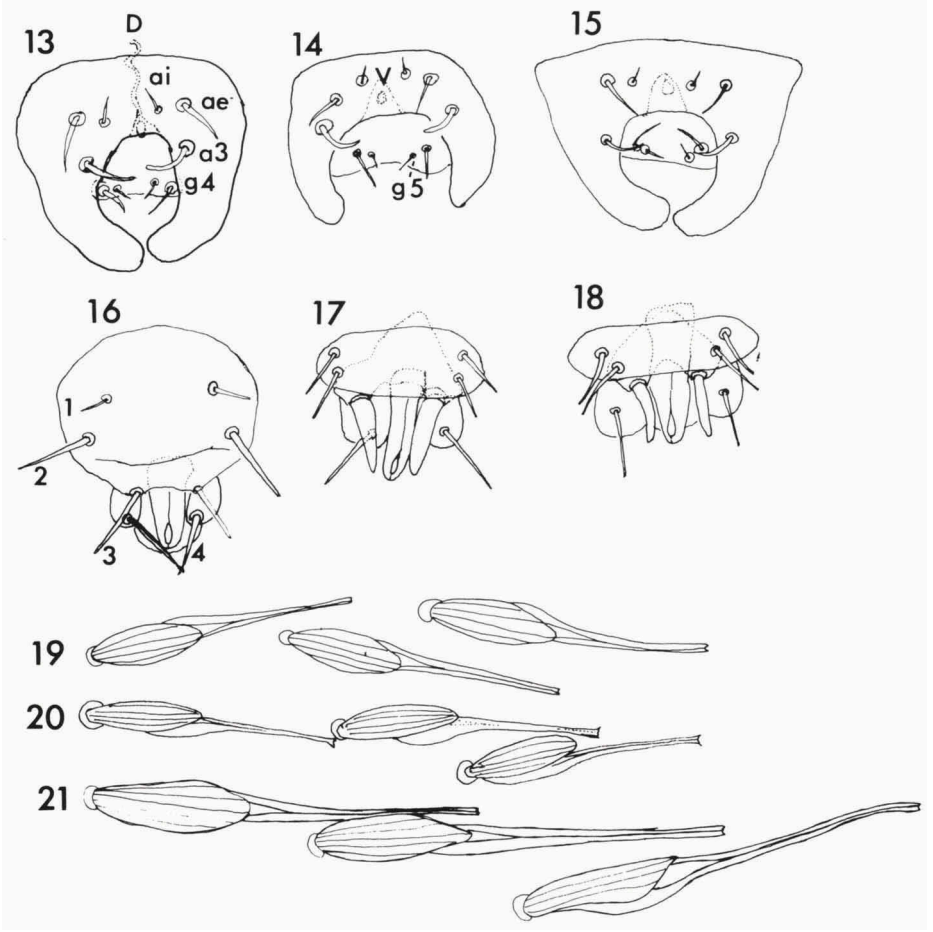
A. elongatus and *A. hengererorum* have been reported from several *Sorex* species (Fain et al., 1982). Therefore these should be regarded for complexes of closely related species.

Amorphacarus parvisetosus specimens from several *Neomys anomalus* localities show small differences in the measurements, however not sufficiant for separation from typical *A. parvisetosus* from its usual host species *N. fodiens* (Klompen & Lukoschus, unpublished observations). *Amorphacarus parvus* and *A. parvisetosus* from hosts of the tribe Blarinini differ greatly by their broad body shape, the short setiform *d 1 - d 3* setae in the female and by the long laterals 1 in the male. *A. hengererorum* parsitic on Nearctic *Sorex*

	A. elongatus	*A. soricis*	*A. alpinus*	*A. yezoensis* spec. nov.
FEMALES				
length	470 (410-500)	500	489 (430-530)	572 (500-659)
width	222 (192-248)	260	233 (200-265)	300 (260-352)
width / length	2.1	2.2	2.1	1.9
v i	33 (30- 37)	37	30 (28- 35)	34 (30- 38)
v e	70 (67- 80)	80	66 (60- 73)	85 (80- 94)
sc i	30 (28- 33)	29	26 (23- 38)	27 (24- 33)
sc e	180 (170-210)	200	175 (155-220)	201 (194-220)
sc i on level of *sc e*	same	posterior	posterior	same
d 1	50 (45- 57)	42	51 (48- 53)	66 (60- 71)
d 2	51 (48- 60)	40	52 (50- 54)	67 (62- 76)
d 3	52 (46- 58)	40	53 (50- 55)	71 (65- 77)
d 4	25 (23- 26)	8	25 (21- 27)	24 (23- 26)
d 5	28 (25- 30)	7	23 (20- 26)	31 (30- 35)
d 1 – d 2	36 (25- 44)	62	56 (43- 64)	43 (30- 51)
d 2 – d 3	32 (25- 44)	25	33 (25- 40)	43 (32- 53)
d 1-2 / d 2-3	ca. 1.1	2.5	ca. 1.7	ca. 1.0
ℓ 1	186 (175-200)	235	186 (173-203)	230 (210-270)
ℓ 3	22 (21- 25)	–	21 (19- 23)	23 (21- 25)
ℓ 4	18 (17- 21)	6	15 (13- 18)	16 (13- 18)
ℓ 5	356 (300-385)	?	287 (270-300)	362 (320-386)
d 1 on level of *ℓ 1*	same	same	posterior	same
ic 1	15 (13- 17)	–	11 (8- 13)	15 (13- 16)
ic 2	18 (17- 20)	–	12 (10- 15)	18 (16- 20)
ic 3	25 (22- 28)	–	19 (18- 23)	28 (26- 30)
ic 4	28 (25- 30)	10	25 (28- 38)	40 (37- 44)
ic 4 – ic 4	40	87	37	55
MALES				
length	404 (392-428)	408	392 (380-410)	490 (410-527)
width	163 (127-182)	215	152 (140-165)	222 (200-255)
length / width	2.4	2.6	2.6	2.2
v i	10	11	9 (8- 10)	10 (9- 11)
v e	64 (58- 70)	59	53 (50- 58)	65 (60- 73)
sc i	8 (7- 10)	12	11 (10- 13)	10 (8- 11)
sc e	60 (50- 75)	150	58 (50- 64)	130 (120-160)
v i on level of *v e*	same	anterior	same	same
sc i on level of *sc e*	anterior	posterior	same	same
ℓ 1	25 (21- 30)	25	47 (43- 53)	33 (30- 37)
ℓ 4	10 (8- 13)	–	14 (13- 18)	13 (10- 15)
ℓ 5	300 (280-360)	?	280 (270-310)	345 (300-360)

Table 2. Comparison of measurements of *Amorphacarus* species.

species is unique by the presence of four pairs of similarly shaped dorsal setae in the female. The remaining four species are morphologically closely related. Measurements of the new species are compared in table 2 to those from related species: *A. elongatus* from the typical host species in The Netherlands, *A. alpinus* from the original description and additional data from specimens, and in *A. soricis* from the original description only. *A. yezoensis* is the largest known species of the genus with distinctly longer *d 1 - d 3* in females. The width in both sexes is intermediate between species from Blarinini hosts and species described from *Sorex*. Females of *A. yezoensis* and *A. elongatus* are



Figs. 13-21. Comparison of details of *Amorphacarus* species: Female genital region of *A. yezoensis* (13), of *A. elongatus* (14) and of *A. alpinus* (15). Male genital region of *A. yezoensis* (16), *A. elongatus* (17) and *A. alpinus* (18). File of dorsal setae 1-3 of female of *A. elongatus* (19), *A. alpinus* (20) and of *A. yezoensis* (21).

similar in the distance ratios of setae *d 1 - d 2 / d 2 - d 3*, the position of *sc i*, and the slightly broadened *ic 3* and *4*, but males of *yezoensis* are similar to *A. soricis* in having long *sc e*, and to *A. alpinus* in the position of *sc i*.

In arthropods with sclerotized surface and genital appendages, small differences in primary and secondary sexual organs often serve as barriers against panmixis. In more primitive Myobiid genera the female vulva lies exposed on the dorsal surface surrounded by genital and anal setae, surely tactile, but without visible specializations (e.g. *Archemyobia philander* Lukoschus et al., 1972). The male genital region has a short, stout aedeagus and the genital region lies superficially open, surrounded by a number of relatively simple setae. These setae are partly genital, and partly dorsal setae shifted forwards. In higher evolved genera, portions of the genital regions are highly modified. The vulva opening (fig. 14, V) with the duct along to the receptaculum seminis is partly hidden beneath a skin duplication, formed by longer vulvar valves, arising from the anterior side of the vulva. The "genital hooks" (*a 3*) on the lower inner side of the valves act together with the valves and genital setae 4 and 5 (highly modified in bat parasites (Dusbabek & Lukoschus, 1975) but not in *Amorphacarus*) in directing the aedeagus point to the vulva opening.

Comparison of vulvar regions of *A. yezoensis* (fig. 13) to those of *A. elongatus* (fig. 14) and *A. alpinus* (fig. 15) shows only minor differences in size and positions. There are greater differences in the male genital regions in species from *Sorex* hosts. The sclerotized plates and four pairs of setae show greater morphological differences between *A. yezoensis* (fig. 16), *A. elongatus* (fig. 17) and *A. alpinus* (fig. 18). The setae of the region, probably not all true genital setae, are provisionally numbered for comparison. It is suggested that the penis sledge also is formed by specialized setae. Procedures and optics do not allow one to be sure whether a pair of tiny setae will be present near the base of the sledge like in the related species *A. parvisetosus* and *Gymnomyobia nectogale* Fain & Lukoschus, 1976. In *A. yezoensis* three pairs lie on the almost round anterior genital plate, which is divided by a folding line behind the level of setae 2. The posterior part is a skin duplication, lying above the sledge and the posterior sclerotization with seta 4. In the copulation position the posterior part of the plate with setae 3 and the penis sledge are turned craniad along the folding line. In *A. elongatus* and *A. alpinus* the posterior parts of genital shields are transformed to a skin pouch, with broadened setae 3 lying inside the body beneath anterior part of the genital plate. In *A. elongatus* from *Sorex minutus* in copulation position (we do not have specimens from the typical host species in this position) the skin pouch with setae 3 and penis sledge is bent around the posterior border of the

anterior shield with setae 3 directed craniad between the caudo-laterad directed setae 2.

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